

REMARKS/ARGUMENTS

Claims 1, 4-8, 10-12 and 16-19 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Williams et al. in view of Yakshin et al. and further in view of Tanaguchi et al., and further in view of Yamada et al. For the reasons set forth hereinafter, it is requested that the Examiner reconsider and withdraw this rejection.

In the Amendment filed on March 7, 2008, all of the claims 1, 4-8, 10-12 and 16-19 were amended to include the recitations of the allowed claims 13-15. It is again submitted, and the Examiner has recognized, that these claims are allowable over the teachings of Williams et al., Yakshin et al., and Tanaguchi et al for the reasons set forth in the Amendment filed on September 13, 2007.

Williams et al. discloses a technique in which a group I-VII semiconductor single crystal thin film is formed on a buffer layer with a beam being irradiated thereto. Yakshin et al. discloses a technique for forming a thin film on a substrate in which the thin film is formed by use of an electron beam so that a high quality film is formed without being mixed with a lower layer. Tanaguchi et al. disclose that a single crystal silicon has a higher electron mobility than that of a polycrystalline silicone.

All of the claims in the present application have been amended herein to recite that the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity, and has a roughness in the order of 2nm. This recitation is for the purpose of emphasizing the advantages of Applicant's group I-VII semiconductor single crystal thin film and process for producing same over the teachings of the newly cited reference to Yamada et al. In addition, Claim 1 and dependent Claims 4-7, and Claim 8 and dependent Claims 10-12 all recite that the

acceleration voltage HV of the electron beam is $0(\text{kV}) < \text{HV} \leq 30 (\text{kV})$; Claims 16 and 18 recite that the filament current FI of the electron beam is $0 (\text{A}) < \text{FI} < 5 (\text{A})$; and Claims 17 and 19 recite that the irradiation current HI of the electron beam is $0(\mu\text{A}) < \text{HI} \leq 150(\mu\text{A})$. It is submitted that Yamada et al. fails to supply the deficiencies of the other cited references with respect to these novel recitations in Claims 1, 4-8, 10-12 and 16-19.

The Examiner states that Yamada et al. teaches a process wherein the electron beam's acceleration voltage is 15 kV, well within the range of 0 to 30 kV, and that such a low amount of kV is used to prevent breakdown of the growing film which can potentially destroy the device. The Examiner further states that Yamada teaches how thermal degradation can occur when the irradiation current density is $1\text{A}/\text{mm}^2$ or higher. The Examiner further states that it would have been obvious to a person having ordinary skill in the art at the time the invention was made to understand that, if the irradiation current was 1mA as taught by Yamada et al., then the filament current must be no greater than 1mA.

It is noted, however, that Yamada et al. discloses the arrangement adopting a ferroelectric crystal, which is different from a group 1-VII semiconductor single crystal thin film in the subject application. Also, increase in the nonlinearity (3rd order nonlinearity) of the group 1-VII semiconductor single crystal thin film is different in the order of the nonlinearity from the nonlinearity (2nd-order nonlinearity) obtained by incising diffractive gating in the ferroelectric crystal or Yamada et al.

Further, Yamada et al. has the arrangement that (i) irradiates an electron beam on a crystal layer having been formed, and (ii) uses the electron beam at the acceleration voltage 15 kV so as not to cause the breakdown by the irradiation. On the other hand, the present invention

has the arrangement in which the electron beam of acceleration voltage HV, for example, in a range of " $0 < HV \leq 30$ " in claim 1 is irradiated on the group 1-VII semiconductor single crystal thin film while the group 1-VII semiconductor single crystal thin film group is being formed. This attains an advantageous, unexpected effect such that the group 1-VII semiconductor single crystal thin film, which (a) exhibits uniform planarity and crystallinity and (b) is absolutely free from the breakdown, can be obtained. Thus, a person skilled in the art could not have easily arrived at the present invention in the amended claims based on the teachings of Williams et al., Yakskin et al., Taniguchi et al., and additionally Yamada et al. which fails to supply the deficiencies of the other references with respect to the amended claims.

All of the claims are amended herein to include the recitation that "the film is of uniform planarity and crystallinity, and has a roughness in the order of 2nm". Thus, these claims clearly refer to the advantageous effect of the present invention, i.e. excellence in planarity and crystallinity.

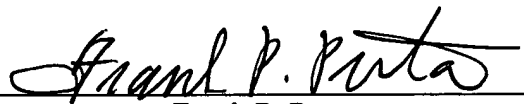
It is submitted that the effect that "the group 1-VII semiconductor single crystal thin film which exhibits uniform planarity and crystallinity is formed" is advantageous, and such an advantageous effect is not disclosed or suggested in the cited references. There is no motivation to combine the teachings of the Williams et al., and Yamada et al. references, and a person skilled in the art could not expect to attain the effect of the subject application by adopting the electron beam of Yamada et al. instead of the beam of Williams et al. Further, the Examiner states that "(these values) are merely parameters of the electron gun itself" and "it is not inventive to discover optimum or workable ranges by routine experimentation". However, it is submitted that it is extremely difficult to find out a condition to obtain a wholly unexpected

effect from enormous numbers of parameters and experimental conditions. For this reason, it cannot be said that the novel recitations in independent claims 1, 8 and 16 through 19 are obvious based on the teachings of the cited references.

In view of the above amendments and remarks, it is submitted that claims 1, 4-8, 10-12 and 16-19 clearly are allowable over the combined teachings of the cited references, and formal allowance thereof is earnestly solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 
Frank P. Presta
Reg. No. 19,828

FPP:lcb
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100